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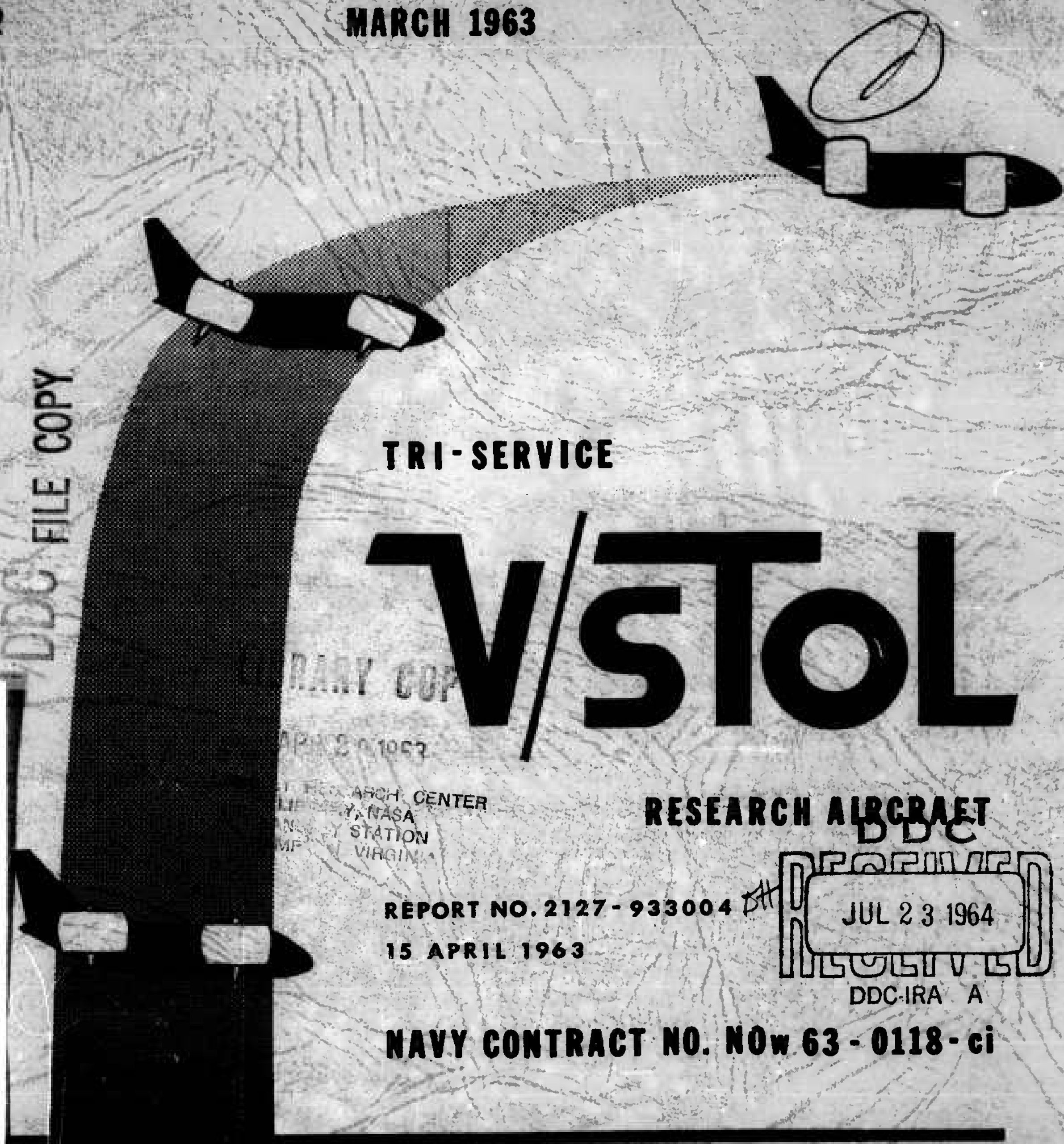
X-22A PROGRESS REPORT NO. 4

MARCH 1963



TRI-SERVICE

V/STOL

RESEARCH AIRCRAFT

REPORT NO. 2127-933004

15 APRIL 1963

NAVY CONTRACT NO. NOw 63-0118-ci

BELL AEROSYSTEMS COMPANY
DIVISION OF BELL AEROSPACE CORPORATION-A textron COMPANY

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BELL AEROSYSTEMS ~~COMPANY~~ Buffalo, N.Y.

X-22A TRI-SERVICE V/STOL AIRCRAFT.

MONTHLY PROGRESS REP~~ORT~~. no. 4, 1-31 March 63

Rep~~ort~~ No. 2127-933004

~~March~~ 1963

This is the fourth Monthly Progress Report as required in Section F (5) of the contract, and outlines progress for the period 1 March 1963 through 31 March 1963

A. J. Marchese
Project Director
X-22A PROGRAM

CONTENTS

CONTENTS (CONT)

ILLUSTRATIONS

I. INTRODUCTION

Bell Aerosystems Company was awarded Contract NOw 63-0118-ci by the Department of the Navy, Bureau of Naval Weapons for two Model X-22A Tri-Service V/STOL aircraft. The official negotiated contract was authorized on 30 November 1962. The X-22A aircraft is a dual tandem ducted propeller research airplane (Figure 1), with a prime mission of exploring the mechanical and aerodynamic problem of an aircraft designed and constructed for both vertical takeoffs and landings and conventional type operation. It carries a flight crew of two men in the cockpit, a pilot and copilot, and is capable of carrying a nominal 1200-pound payload. The aircraft will be designed to a target value for weight empty of 10,635 pounds, a speed of 303 knots, and endurance of 1.09 hours.

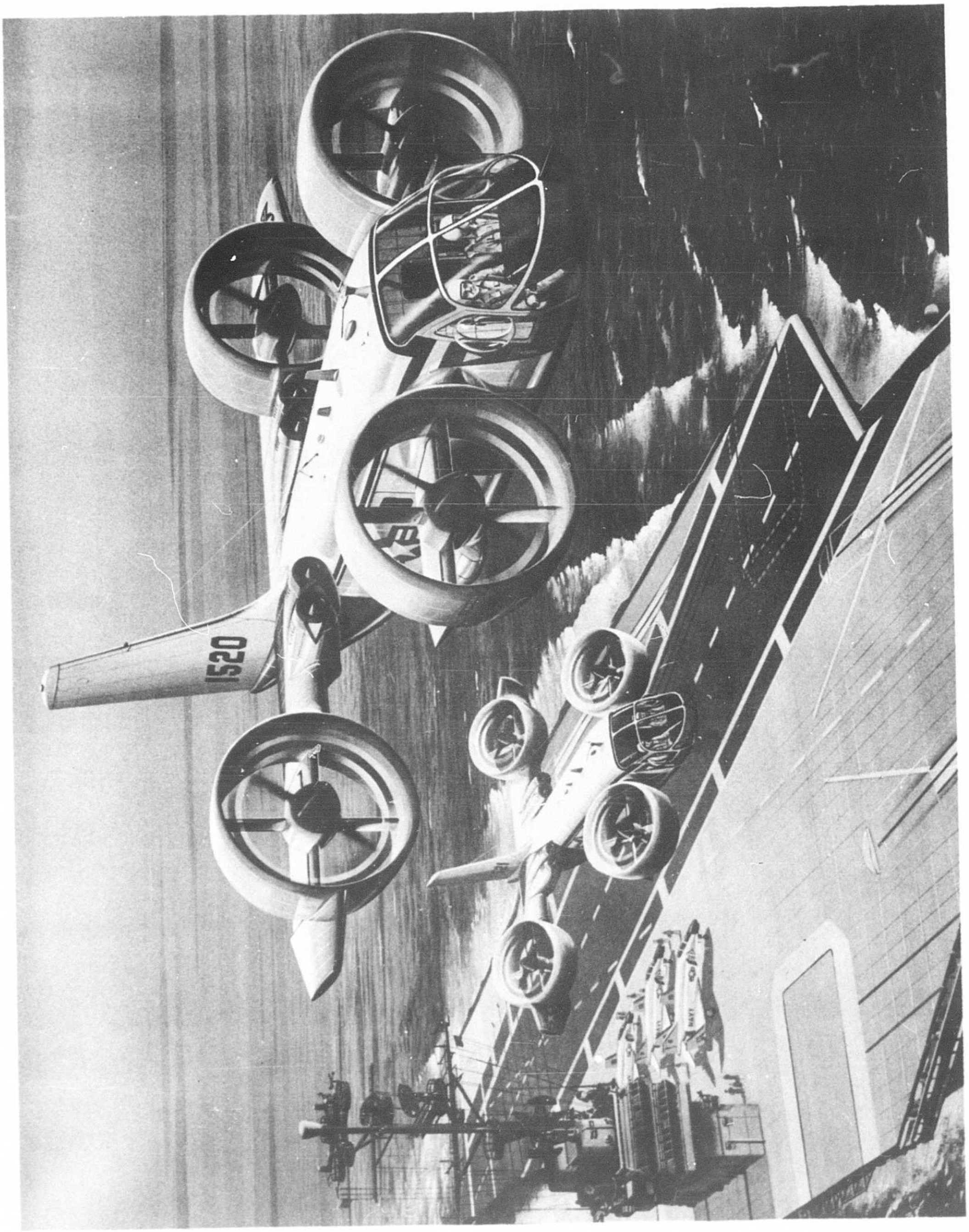

Figure 1. X-22A Tri-Service V/STOL Aircraft

II. SUMMARY

A

Preliminary design work, performance and weight studies, and calculation reviews of various configurations which are in progress h~~ave been~~n ~~in work~~ ~~since go-ahead~~ on ~~this program~~ will ~~now~~ be reduced to the detail systems and component levels. The engineering effort is aimed at a Design Freeze ~~in the~~ month of ~~May~~ this being one of the major milestones on this program.

The Wind Tunnel program, design, fabrication, and test is essentially on schedule.

Proposals from ~~five~~ vendors for the design, fabrication, test, and delivery of the Transmission Systems (gearboxes and shafting) are being reviewed and evaluated in pr~~eparation of awarding~~ a subcontract.

Receipt of BuWeps approval of the preliminary procurement specification for the Variable Stability System will allow this contractor to place a subcontract for this system.

The ~~Douglas~~ Escapac ID (BA) seat has been selected for use on this aircraft. (Reference Bell letter No. 94 dated 12 March 1963, which requested formal BuWeps approval.)

Effort in finalizing procurement specifications and work statements for other required subcontracts is continuing.

During this period, all contractual data requirements were completed as scheduled.

Management controls (PERT scheduling and costing) are continuing. Nets and EDP runs are still being expanded and improved on an expedited basis. The first PERT COST report from this effort was issued, as scheduled, on March 13, 1963.

Schedules and expenditures for this report period were within the Departmental Work Instructions (DWI) issued to each operational department, and to the PERT schedules insofar as contract commitments are concerned.

III. PLANNING

Progress between 1 March 1963 and 31 March 1963 has continued in the detail planning of all program efforts. In PERT schedules, we are continuing to revise our original top level nets into expanded detail nets as stated in the last report. We have instituted a temporary overtime effort in the PERT Engineering Section to expedite this effort. During March, the networks have been updated resulting in Revision 16 of Network 2127-PN-200. The PERT Milestone Computer report and the PERT Interim Report for the month of February were submitted to BuWeps on schedule.

This contractor presented our PERT/Cost methods to BuWeps personnel 14 March 1963. The discussion and review of our efforts and resulting data was accepted by BuWeps.

Again, as indicated in the last report, until this PERT/Cost program has been completely debugged and oriented into our operations, budgets in line with negotiated costs through April 1963 have been issued and are being used by each operational department. Daily reviews of these budgets are being made and expenditures through 31 March 1963 are within the authorized funds for this period. The authorized direct labor hours for each net, through the use of the PERT/COST EDP run, is being released as the operating official hours to each department as soon as each detail net is completed and the estimated hours assigned.

Figures 2 and 3, X-22A Milestone Data Requirements Charts, for periods through March 31, 1963 and 2nd Quarter 1963, and Figure 4, Program Schedule, reflect the program as of 31 March 1963.

All operation departments are continuing with necessary planning and interdepartmental coordination as required, spearheaded by a weekly meeting attended by all members of the X-22A Management Organization.

The Engineering and Manufacturing weekly meetings to discuss and review designs, techniques, specifications, equipment, etc., are continuing.

Progress is continuing on planning and establishing requirements for conducting test programs such as noise and vibration, acoustic fatigue of prime elements, propulsion system, etc.

The first Weapon System Master Plan was distributed 30 March 1963.

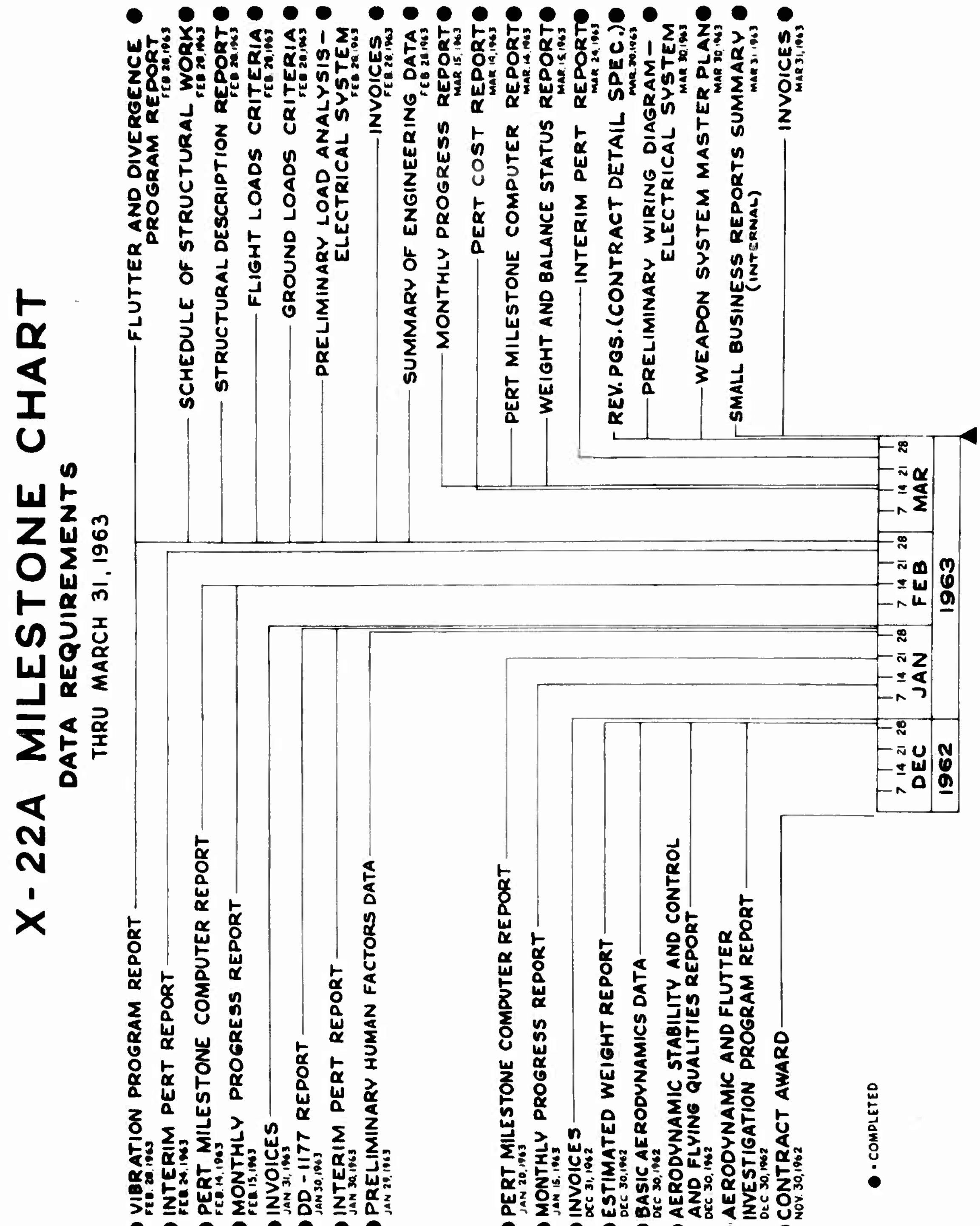

Figure 2. X-22A Milestone Chart - Data Requirements through March 31

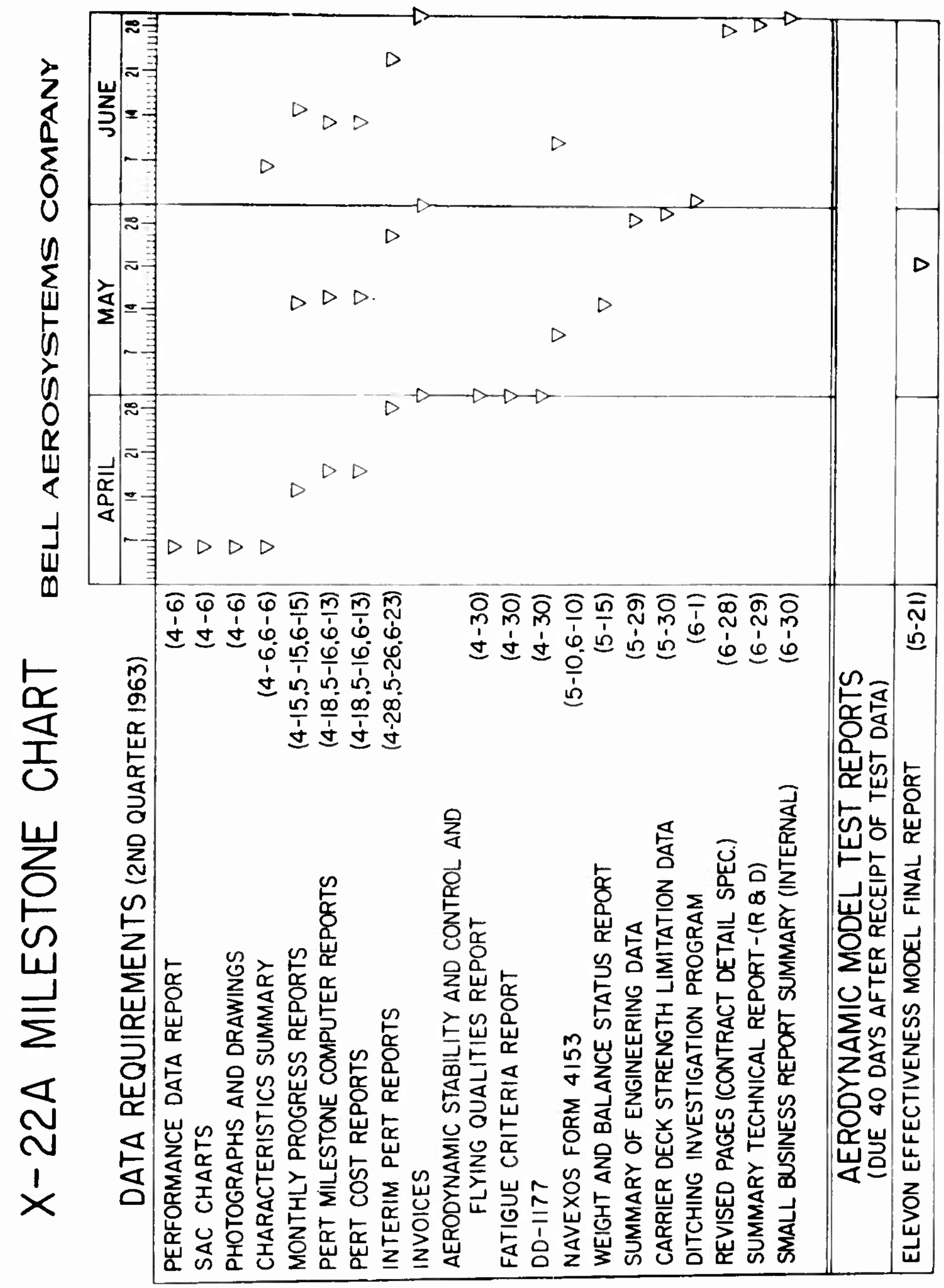

Figure 3. X-22A Milestone Chart - Data Requirements (Second Quarter)

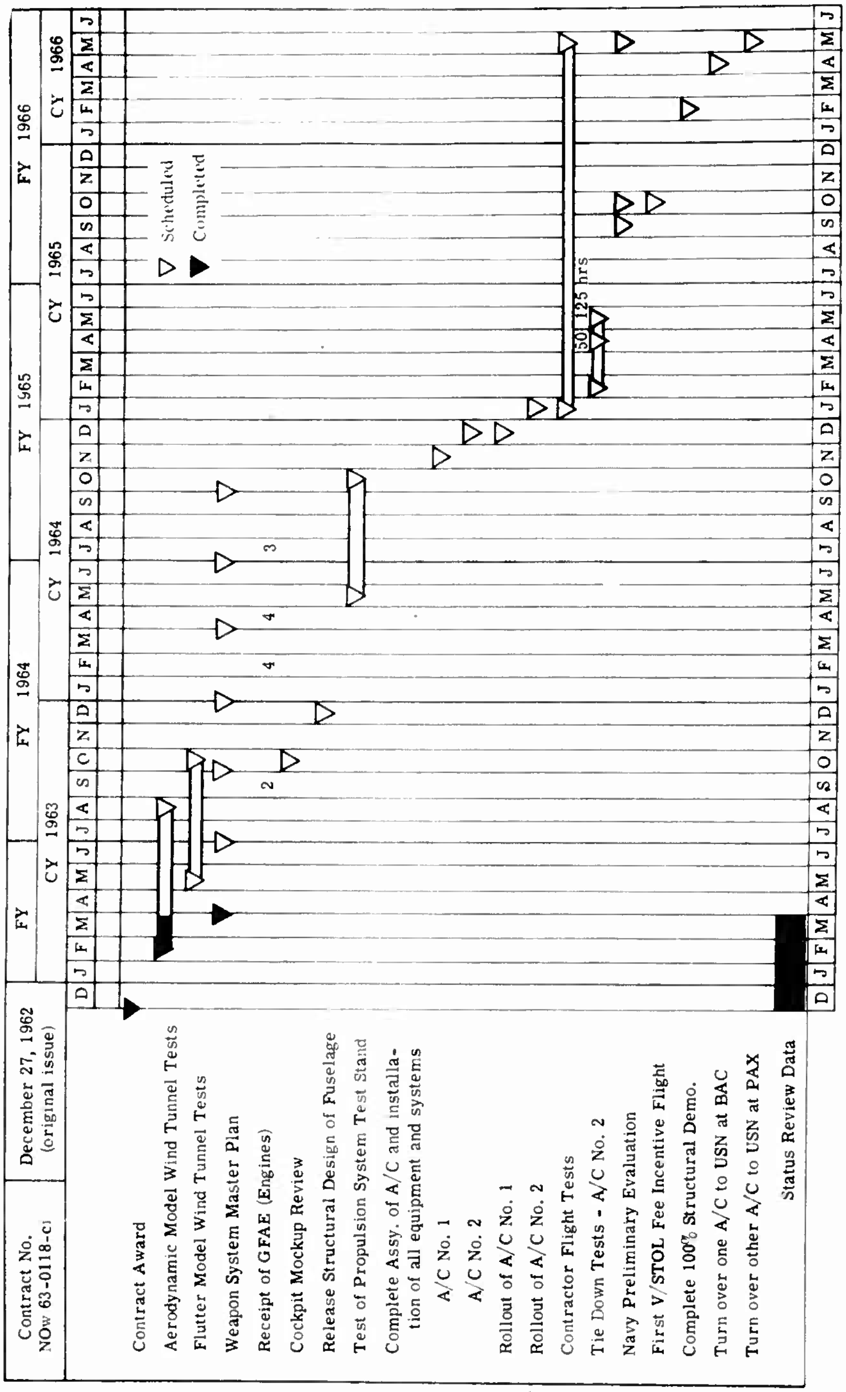

Figure 4. Program Schedule

IV. PRELIMINARY DESIGN

A. FLIGHT TECHNOLOGY

1. Performance

The Standard Aircraft Characteristics Charts and Characteristics Summary were reviewed with BuWeps performance personnel to assure proper content and format. The changes requested by BuWeps are being made and the data will be completed and delivered on schedule.

The Performance Data Report was completed and will be delivered on schedule.

The short takeoff analyses with the high duct angle of attack thrust presently being used, indicate a takeoff distance of approximately 900 feet to clear a 50 foot obstacle, in the maximum overload condition of 17,237 pounds. The gross weight at which a takeoff can be made in 600 feet is 16,000 pounds. The duct thrusts used were based on limited wind tunnel data of a different duct configuration, and should show improvement as data are obtained from X-22A wind tunnel models.

The tradeoff studies for ducted propeller optimization are continuing. A tentative selection of design parameters has been made and a more detailed examination of this configuration is now in progress.

2. Propulsion Analysis

Additional control calculations for high speed and hovering conditions were made to determine maximum propeller blade angle and its effect on thrust and horsepower. It was recommended to retain the

maximum blade angle travel as proposed since the transient torque limit of the gearbox would not be exceeded. Since hovering control decreases with decreasing propeller speed, a recommendation to keep propeller rpm at 100 percent was made. These settings provide sufficient control to meet the specification.

Windmilling propeller rpm calculations were made with power extraction for hydraulic and electrical systems and directional control to verify that propeller speed would remain above 60 percent of takeoff rpm thereby maintaining electrical power.

Duct thrust loss due to elevon deflection during hovering was estimated and did not differ significantly from the proposal values. Extension of the area ratio calculations to include no diffusion and 30 percent diffusion was completed for takeoff and two cruise conditions.

The 1/3 scale powered duct model pretest report is in work and will undergo review during the next reporting period.

Full scale powered duct model forces and moments were estimated along the structural design limit line to 200 knots.

Duct surface velocity and pressure distributions for 150 knots, military power and angle of attack of 24.5 degree (structural limit point) were estimated using method of Dr. S. Pinko. Integration of the pressures gave a total normal force in agreement with the D190B 1/6 scale duct test data.

Thrust horsepower and fuel flow curves were plotted to yield fuel flow directly as a function of thrust required with engine horizontal residuals included for two, three, and four engine operation. Sample

calculations substantiating duct propulsive efficiency and power available at V_{max}, SLS day conditions were also supplied.

Analysis of fuel system operation at various altitudes and temperatures with JP-4 fuel was conducted. An altitude limit of 17-20,000 feet is recommended, based on flight safety and low vapor/liquid ratio. Vapor pressure of JP-5 is lower, indicating more margin before formation of vapor.

Engine nacelle cooling and ventilation air flow during hovering and high speed flight is now in work. Inlet area and location, ejector characteristics, and internal flow considerations will be covered.

Kellett Aircraft Corporation's downwash tests of the X-22A configuration were observed during a trip to that facility. Positive ground effect with some nose down pitching moment was noted from static pressure measurements. Engine exhaust would most likely not be reinjested based on smoke moving aft in the exhaust discharge area. Engine inlet protection for tie-down tests would be necessary due to strong upwash forward of the intake. Duct inlet separation was observed from static pressure measurements on the aft duct. Kellett representatives gave a presentation at Bell on their test results.

Preproposal engineering discussions were held with Therm personnel. Therm will propose ducted propeller analyses in support of the X-22A Propulsion Analysis effort.

3. Stability and Control

Component longitudinal aerodynamic loads data for transition and level flight were completed, consistent with the revised estimated data for the complete airplane. Dimensionalized longitudinal perturbation

derivatives were developed from the transition coefficient data for several conditions of unaccelerated and accelerated transition flights. This data is being used to conduct dynamic longitudinal perturbation analysis for a number of discrete flight conditions throughout transition. This analysis includes the determination of dynamic response to abrupt maneuvers.

The analog computer studies of lateral-directional dynamics and stability augmentation requirements in transition were updated to account for the revised lower roll moments of inertia. Some increase in roll damping is required up to high speeds in transition in order to meet MIL-H-8501A requirements. Since only estimates of lateral-directional aerodynamic characteristics in transition are presently available, the effects of variations in the major derivatives were also investigated.

Typical constant altitude landing and takeoff transitions were calculated and the corresponding aerodynamic perturbation derivatives were determined for initial variable stability system analysis.

A boundary of acceptable C_{n_β} and C_{l_β} for conventional flight was determined on the basis of combined requirements for the dutch roll oscillations, critical load factors in rolling pullout maneuvers and control trim requirements in cross-wind landings. This boundary will be used to make early judgement of wind tunnel test results.

The characteristics of the longitudinal start period dynamics in conventional flight were reestimated using revised aerodynamic derivatives. The results showed increases in damping ratio which provides better longitudinal handling qualities; however, stability augmentation is still required at low speeds.

A compilation of all the stability and control analyses and aerodynamic data development conducted over the past quarterly period is in progress. This is in preparation for the second issue of the X-22A Aerodynamic Stability and Control and Flying Qualities Report.

B. VEHICLE STRUCTURES

1. Criteria and Loads

An IBM program for integrating shroud pressure coefficients has been established. The program will be used to obtain shroud load distributions under various thrust loadings, angles of attack, and free stream dynamic pressures based upon wind tunnel tests performed at the University of Wichita.

Structural and dead weight distributions have been established for various design weights. Fuselage shear, bending moments and torsion data are presently being calculated for the landing conditions specified in the Ground Loads Criteria Report.

Trim angles of attack have been determined for balanced pitch maneuvers at full throttle in both conventional and transitional flight. Similar data is now being determined for cruise throttle settings over the same speed range. This data will be employed in determining flight conditions under which various component loads reach a maximum during balanced pitch maneuvers.

2. Structural Analysis

a. Front and Rear Ducts

An IBM program for evaluation of torsional and bending deformations of the duct including the effect of struts and centerbody is near completion.

With respect to detail design, current emphasis is concerned with the analysis of the main duct support tube and the detail areas at the bearing supports.

A simplified torsional analysis of the duct indicates structural feasibility for reducing the outer duct skin thickness, from the main beam aft to the trailing edge. A potential weight saving is subject to verification by future acoustical tests on a representative section of the duct structure.

b. Wing and Duct Support Structure

Shear and bending analyses of the wing box and trailing edge structures were continued and resulted in reductions in the respective element areas. The beam caps, trailing edge covers and three upper surface stringers were reduced in thickness. In addition, the upper and lower surface stringers were respaced because of the elimination of a stringer on both the upper and lower covers and because larger skin panels forward of the rear beam are acceptable.

Deflection analyses are being conducted on the wing and engine support beam with regard to transmission shaft misalignment and engine cowling clearances with the fairing adjacent to the fuselage combined vertical and lateral deflections of about 1.5 and 0.5 inches, respectively, can occur under maximum loads.

c. Fuselage

Studies of the cargo tie-down system showed the best structural arrangement is achieved when the tie-down points are located midway between two fuselage frames. Frame weight is reduced by utilizing frames which were previously used to stiffen the skin only.

Nose gear trunnion support was established as a 7079 aluminum alloy fitting which is cantilevered off the canted bulkhead and supported by the seat rails. Further studies are being conducted to confirm that this arrangement does not affect the ejection system. The canopy analysis was programmed on the IBM 7090. Results of this program show the plexiglass deflections to be large. Further studies are being conducted considering both bending and membrane effects.

d. Stabilizer

General stress and stiffness analyses continued on the redundant attachment to the duct wall and on the determination of the effective EI and GJ properties and elastic axis location.

e. Transmission System

Slight structural design improvements appear possible in many of the proposed transmission systems.

3. Aeroelasticity and Flutter

Equations for symmetric flutter analysis have been set up. The equations include effects for 15 degrees of freedom (see Table IV of Bell Aerosystems Report 2127-941030 for itemization). Input data have been established for preliminary analyses which will be limited to 9 degrees of freedom, stabilizer and elevon modes having been deleted. These preliminary analyses will be conducted to check out the overall configuration from the standpoint of flutter susceptibility. Symmetric analyses have just commenced. No results are available as yet.

Equations for antisymmetric flutter analysis are also being developed. The major degrees of freedom to be investigated are also

itemized in the Table noted above. Development of those equations is approximately 50 percent complete.

4. Weights

Delivery of the first Weight and Balance Status Report, 2127-942002, was made to BuWeps Rep on schedule. Therein, a 23 pound weight empty increase was substantiated. The weight empty at the end of this reporting period, however, is 10,621 pounds, which is 14 pounds under the guaranteed weight empty. The major weight reduction occurring this month is in the propulsion duct supports. Previously, weights for a single bearing supporting concept were reported, however, the current configuration consists of the more efficient two bearing support arrangement similar to the originally proposed.

Detailed weight review of the wing, fin, fuselage, and duct structure has been completed this month. Results indicate no foreseeable weight problems. A weight control system based on detailed design target weights has been established which, if met, will result in a weight empty under the guaranteed weights empty. Weight checks of flight controls have been started. Gearbox cooling systems and the fire extinguishing system, both of which are currently overweight are receiving concentrated weight reduction efforts.

C. DESIGN

1. General Design

The single fuel tank continues as the basic consideration.

As a result of visits to BuWeps during this period, a new instrument panel arrangement will be designed and incorporated in the cockpit mockup.

Continued studies of the fuselage are being made, particularly in the wing and fin area.

Decisions have been made to use a two bearing spindle mounting system for duct support. The harmonic drive has also been adopted, due to low weight, small space envelope, and cost.

Overall investigations of flight controls and engine controls continue, as well as electrical and hydraulic routings. Special emphasis is being given to the areas of the forward and aft duct supports.

Studies of the cargo areas and balance considerations show that the best seating arrangement for passengers is three passengers on the right side and one on the left side of the forward area, plus two passengers in the aft cargo area.

Evaluation of the transmission system proposal by all design sections is being made.

A finish specification has been prepared and is in final review by the affected departments.

The design of the test setups for acoustic noise tests of the duct has been completed.

2. Airframe

The full size lines have been released for the cockpit mockup.

Detailed studies of fuselage wing, and fin attachment continue. Longerons have been relocated to obtain minimum longeron weight.

Layouts of the fuselage duct support fitting as well as the incorporation of harmonic drive are underway.

The fuel tank area is being investigated, as well as access to allow insertion of the main cell and sump, and subsequent servicing of these items.

The canopy and windshield areas, as well as their supporting structures, are in the layout phase and have been released to Manufacturing for the cockpit mockup.

Detail studies of fin attachment are nearing completion.

Layouts are continuing on the duct and supporting structure. These layouts incorporate the latest thinking on center body supporting structure.

The basic layout of the fuselage and duct support area now incorporates the latest thinking on spindle mounted needle bearings, harmonic drive duct rotation and studies of duct mechanical stops.

Layout of the fuselage and nacelle intersection area are underway.

A layout of the engine mount pylon is in work, and methods for obtaining structural engine mount redundancy are being investigated.

The fuselage centerline layout data drawing has been completed.

Paragraph 3.2.4.1 of Specification SD-550-1 requires that the airplane have the maximum practicable watertightness to maintain buoyancy for a period of 10 minutes. A leakage test through a typical fuselage skin splice specimen (Figures 5 and 6) was preformed to demonstrate the flotation capability of the fuselage without special caulking of the joints. The test showed that only 1.6 gallons of water could be taken aboard the fuselage through the skin splices in a 10 minute period.

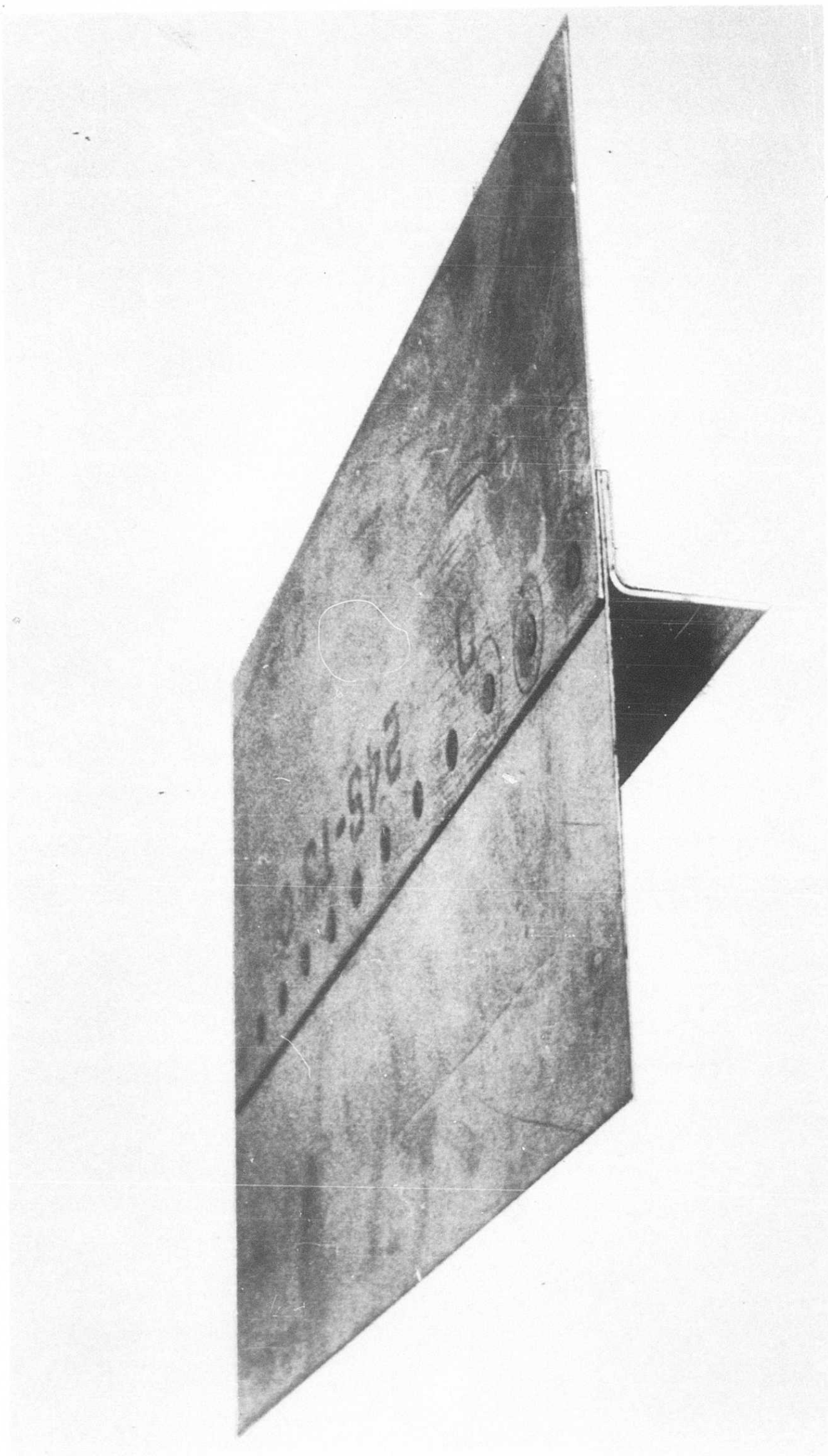

Figure 5. Leak Test Panel

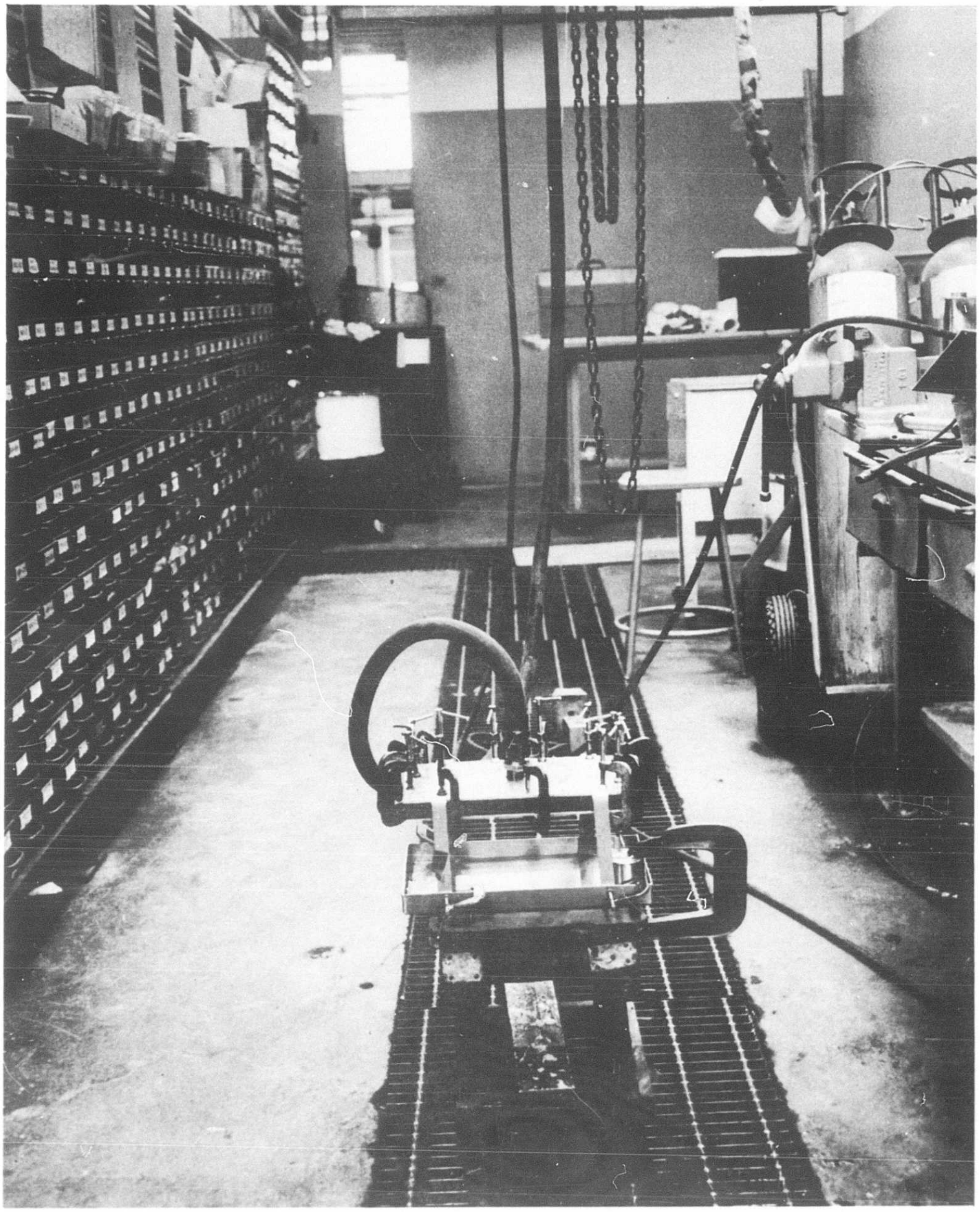

Figure 6. Leak Test Panel – Test Setup

3. Flight Controls and Equipment

Detail layout of the cockpit linkage is continuing.

The inboard profile has been issued internally for use on a preliminary basis.

The layouts of the cockpit areas including consoles, seats, and controls have been completed and released to Manufacturing for mockup.

A layout of the flight controls routing through the duct rotation joint has been started.

Layouts of control cables and associated equipment are being continued.

All canopy lines have been released for the cockpit mockup.

The Douglas 1D seat on loan to Bell Aerosystems has been received and will be used on the three-dimensional layout.

The submittal drawing for the flight control system installation has been started.

Cockpit mockup progress is shown in Figures 7 and 8.

4. Propulsion

Layouts of the duct and centerbody are underway and a specification drawing of the propeller gearboxes envelope and interfaces is essentially completed.

The layout of the Beta control system is continuing and space allocations for it have been made.

Layouts of the fuel system and fuel tank are continuing. Installation of the main tank and sump tank will be accomplished through

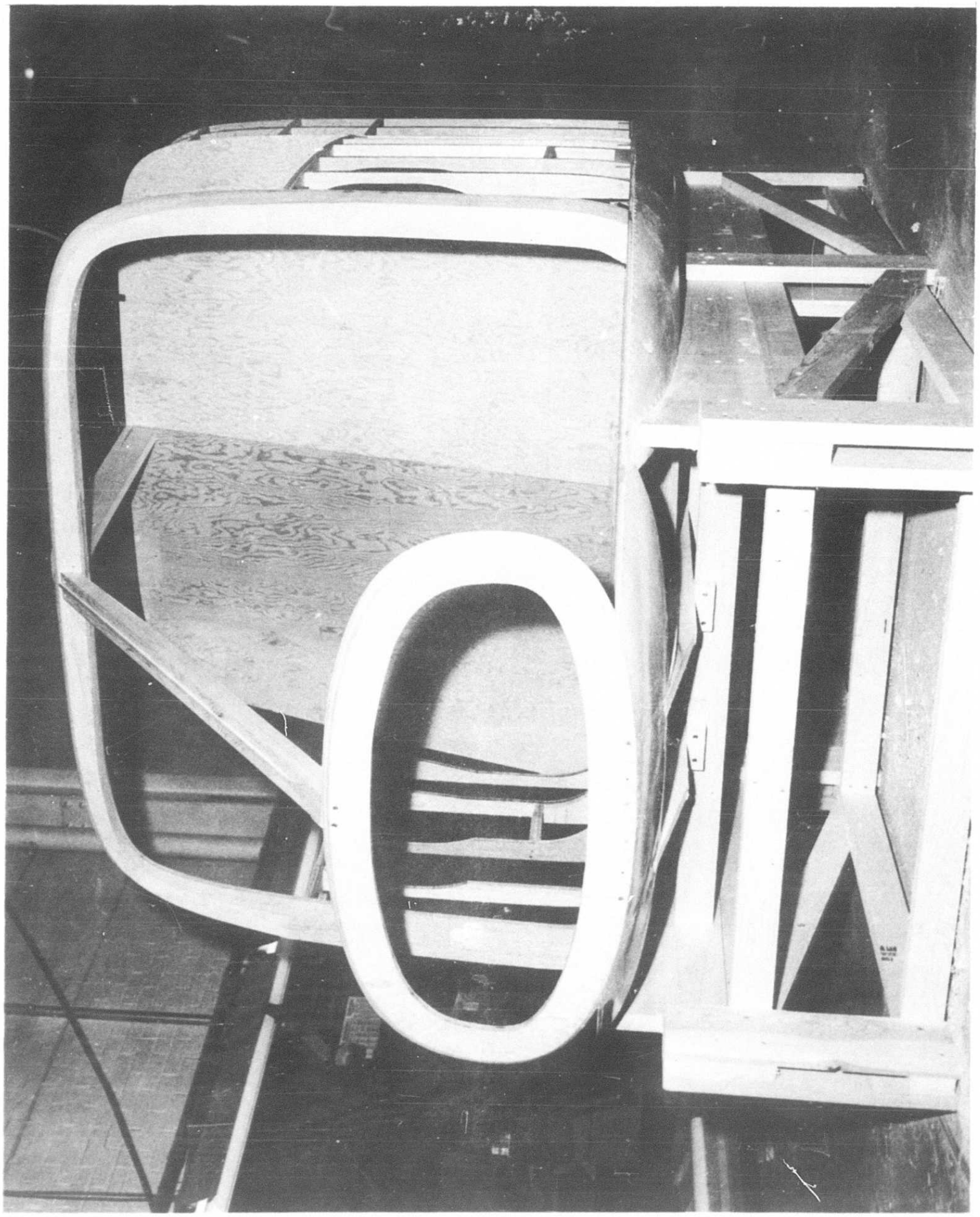

Figure 7. Cockpit Mock-up – Front View

Figure 8. Cockpit Mock-up - Left Side View

an access hole directly under the sump tank. This arrangement will also give access for fuel connections to the sump tank.

A general layout of the engine installation, cowling, engine support, controls and provisions for servicing is underway.

Routing of controls, expecially in the area of fuselage and duct, is being studied.

Planning for the propulsion test stand and test requirements is underway and a tentative test site has been selected. The first draft of the test plan is nearing completion.

The propulsion system schematics are being reviewed prior to issuance to BuWeps.

The submittal drawings of the fuel and oil systems have been started.

Engine controls layouts in the fuselage have been completed for checking among the groups.

5. Electrical and Electronic

The preliminary schematics and block diagrams were completed and transmitted to BuWeps.

A study is in progress to determine the feasibility of eliminating the battery. BuWeps has informally agreed to this if we can demonstrate sufficient windmilling power to provide emergency electrical power.

An investigation is being made for the elimination of one constant speed drive unit which will be presented to BuWeps, providing they agree to the deletion of mission completion power requirements.

Work has been completed on the preliminary lighting schematic circuits, and they are now ready to be put in drawing form.

6. Landing Gear and Hydraulics

Information is being prepared for transmittal to BuWeps for concurrence to eliminate the utility hydraulic system. This has been discussed with and informally concurred in by BuWeps personnel.

The landing gear arrangement drawings have been reviewed at BuWeps. The configuration was informally approved and the finalized drawings will be released shortly with the landing gear procurement specification.

During a visit to BuWeps, the tire for the main gear was discussed and it was agreed that the 24 x 5.5 12-ply tire could be uprated and used on this airplane.

Layouts of hydraulic lines routing through the duct rotation joint are in work.

The nose and main gear specification and specification control drawings are nearing completion.

D. SYSTEMS SUPPORT

1. Human Factors

Control-display requirements are being categorized as operational or flight test. Flight test items will not be included in the deliverable version of the cockpit.

Analysis of control-display requirements in certain unresolved areas continues. A questionnaire is being prepared for circulation to test

pilots with VTOL experience in an effort to obtain relevant subjective data. Attention currently is focused on thrust diversion (duct rotation) control, thrust angle display and angle of attack. More general subjects are also included.

2. Environmental Factors

The estimated noise levels in the cockpit, based on reduction calculation of wall and windows are high.

To preclude the addition of unnecessary weight in the form of acoustical insulating material, other means of noise reduction to meet human tolerance and speech commensurates requirements are being studied. Information available reveals that flights are being conducted in aircraft (Grumman Albatross) with cockpit noise levels far in excess of those specified in MIL-A-8806 (130 db) and that speech communication is possible when the noise advanced equipment is used.

A survey of available equipment has shown that the noise level at the pilot's ear can be reduced sufficiently by using earplug-earmuff combinations and more advanced helmet design. BuWeps personnel have suggested the use of the SPH-2 helmet, headset and microphone combination in the X-22A aircraft. We understand that this equipment will soon be identified by a Federal Stock Number, and, if applicable to the X-22A, will allow us to meet the specification requirements.

3. Maintainability and AGE

The maintenance analysis is continuing with emphasis being placed on the aft accessory compartment, control cable routing and fuel cell.

The high density area of the aft accessory compartment presents the necessity of concentrated attention on installation, mounting, location and identification of equipment in this area.

The control cable and pully position of the control system in the fuselage area are being studied to optimize location and routing for ease of maintenance and rigging.

The fuel cell arrangement in the three-dimensional layout presented the opportunity to study access, bladder installation, and flange alignment.

E. SYSTEMS ANALYSIS AND INTEGRATION

BuWeps was visited on 3/7/63 to discuss our proposal to transfer the Variable Stability System weight from Weight Empty to Useful Load. There was a difference of opinion within the Navy whether this proposal should be accepted. As a result, BuWeps requested a definition of the capability-weight-cost tradeoffs involved, and a more detailed weight breakdown of the items in flight controls, variable stability and the shared flight test instrumentation. This information has been obtained and will be presented to BuWeps early in April.

The Cornell Aeronautical Laboratory (CAL) proposal for the Variable Stability System was received and reviewed. CAL and Bell Contract and Engineering personnel have continued coordination meetings to discuss this proposal.

Elevon inertial and aerodynamic hinge moment and damping characteristics were established and are being incorporated into the power servo design study.

F. SUBCONTRACT

1. Propellers

Final specifications, work statements, and delivery schedules are being reveiwed by Hamilton Standard. Negotiations are to resume as of 9 April, with final definitization of the subcontract scheduled for 30 days later.

2. Landing Gear

The nose and main gear specifications are undergoing final review. Proposal packages are being prepared for vendor bid purposes.

3. Ejection Seats

A mockup Douglas Ejection Seat on loan to Bell Aerosystems is being reviewed and studied in the Human Factors mockup. Procurement specifications are being prepared in Engineering.

4. Variable Stability System

Evaluation of proposals has been concluded and technical and cost reviews were held with vendor, and we are awaiting BuWeps approval of the Procurement specifications submitted February 26, 1963.

5. Transmission System

Five vendors submitted proposals and technical and cost evaluations are in process.

6. Duct Rotation System

Preliminary discussions with United Shoe Machinery have been instituted by Engineering on the harmonic drive system.

V. MODELS

A. WIND TUNNEL TEST PROGRAM

1. 1/6 Scale Unpowered Model

The model was installed in the DTMB 8 x 10 ft subsonic wing tunnel on March 25 and the tare and interference runs have been completed. It is expected that the first test period will .ast three weeks.

2. 1/5 Scale Powered Airplane Model

Model design was completed and approved by the test facility (NASA-LRC) and fabrication is in process. The model is presently scheduled to go in the wind tunnel about May 25, 1963. The pretest report is 80 percent complete.

3. 1/3 Scale Powered Duct Model

Model fabrication is in process at DTMB and the model is expected to be ready for test approximately June 10, 1963. The pretest report is 80 percent complete.

4. Full-Scale Powered Duct Model

Preliminary layouts of several approaches to the design of this model were completed and taken to NASA Ames for discussion. The model detail design will be initiated as soon as the results of the discussion have been reviewed at Bell Aerosystems.

5. Elevon Effectiveness Model

The basic tests of this model out of ground effect have been completed and further tests have been added to the program to investigate means of increasing elevon effectiveness (such as adding end plates). The tests in the presence of the ground remain to be run.

6. Free-Flight Model

Fabrication of this model is continuing at NASA Langley.

7. 1/20 Scale Spin Model

A meeting is planned early in April between Bell, DTMB and NASA to discuss the spin model design approach.

8. 1/7 Scale Duct/Wing Flutter Model

Fabrication of the flutter model for test in the DTMB wind tunnel is about 25 percent complete. Delivery is scheduled by May 20, 1963.

9. 1/7 Scale Fuselage Duct Flutter Model

Model design has been reviewed with the NASA Langley test facility. Drawings are being prepared for submission.

VI. MOCKUP

A. COCKPIT MOCKUP

Design programming, planning, and lofting for the transparent enclosures have been completed. Plaster forms for these enclosures are in work. Bulkheads and frames have been assembled and the details for the rudder pedals, collective pitch stick, consoles, and cockpit canopy structure are in fabrication.

B. HUMAN FACTORS MOCKUP

Feasibility of entering or leaving the X-22A cockpit using a single integral step was demonstrated by a 95th percentile subject (see Figures 9 through 13). For this demonstration, the Human Factors three-dimensional layout was elevated to normal ground clearance and a tubular frame representing the canopy in the raised position was added.

A wood and cardboard structure representing the X-22A fuselage has been added to the Human Factors three-dimensional layout (see Figures 14 through 17). It is being used by both Human Factors and design personnel to optimize crew space and equipment arrangement and to evaluate escape provisions.

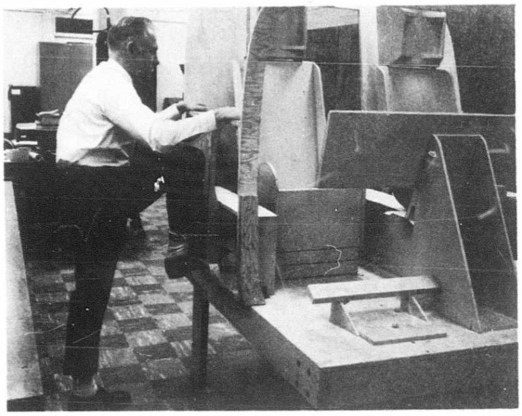

Figure 9.

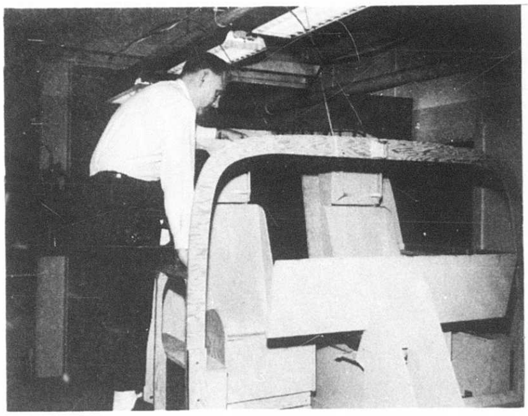

Figure 10.

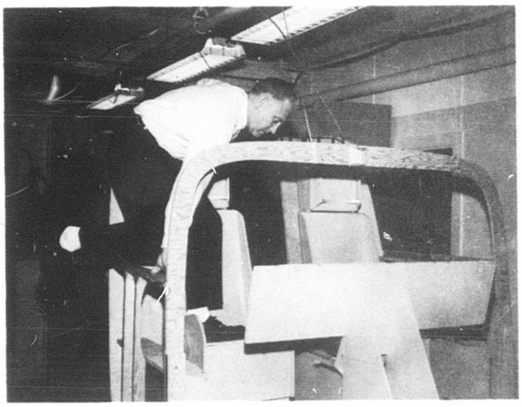

Figure 11.

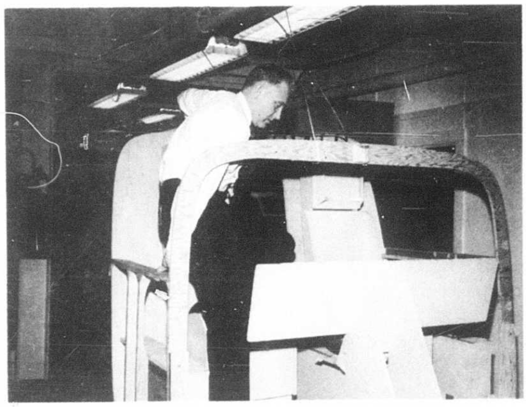

Figure 12.

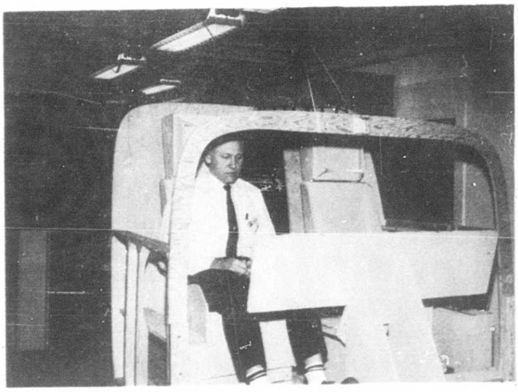

Figure 13. 95th Percentile Entering Cockpit

Figure 14. Forward Crew Compartment – 50th and 95th Percentile (on Left)

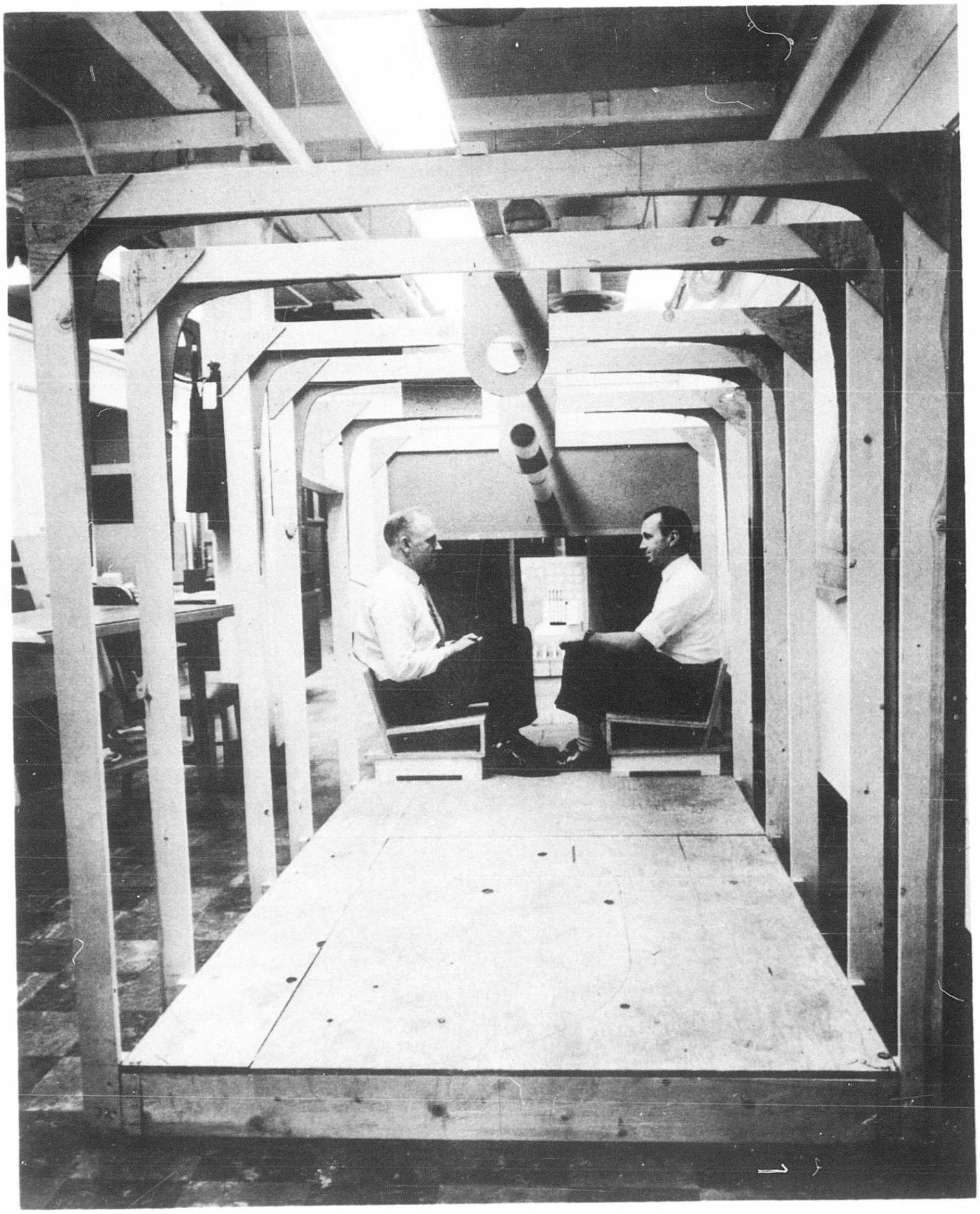

Figure 14. Forward Crew Compartment – 50th and 95th Percentile (on Left)

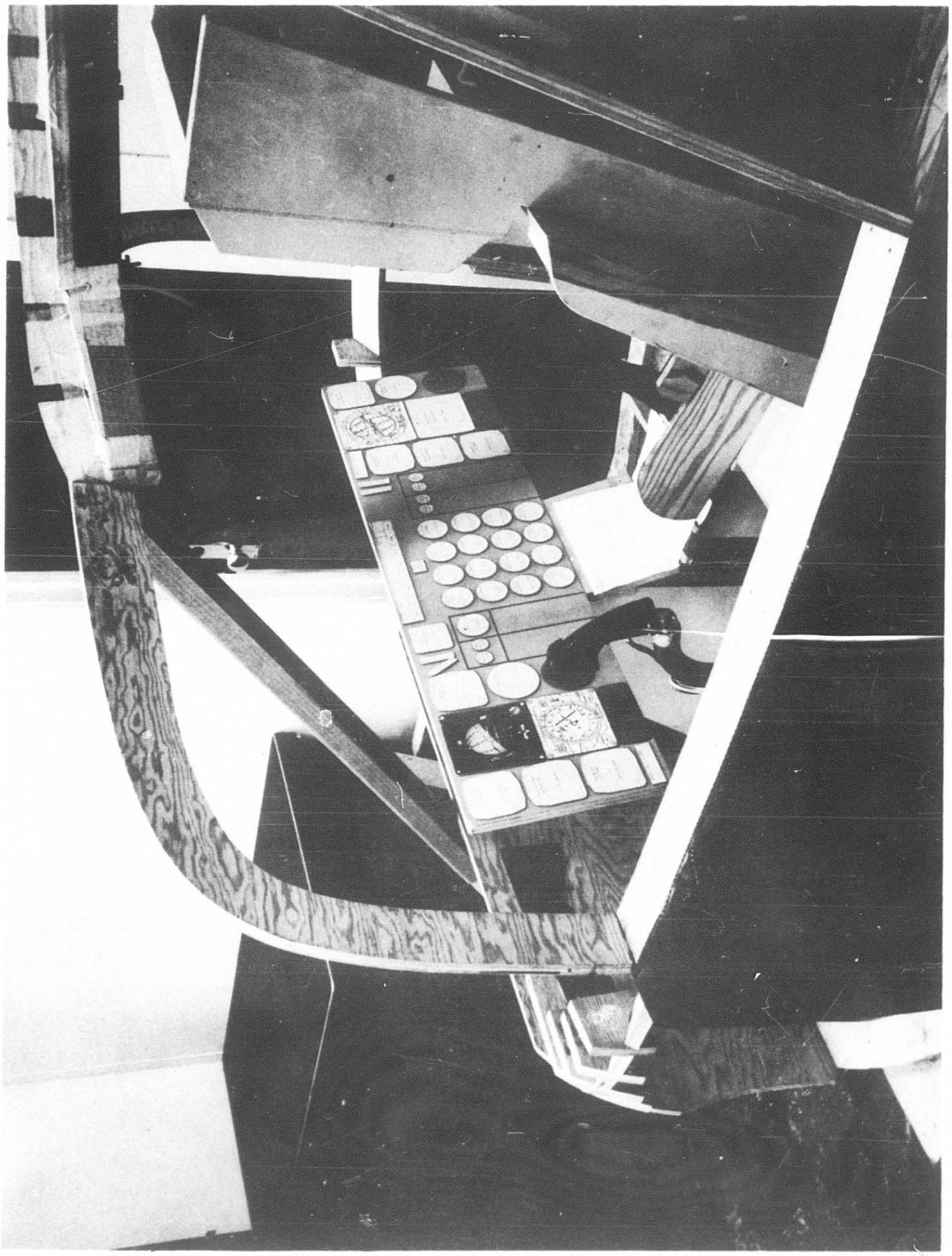

Figure 15. Human Factors Mock-up - Control Panel

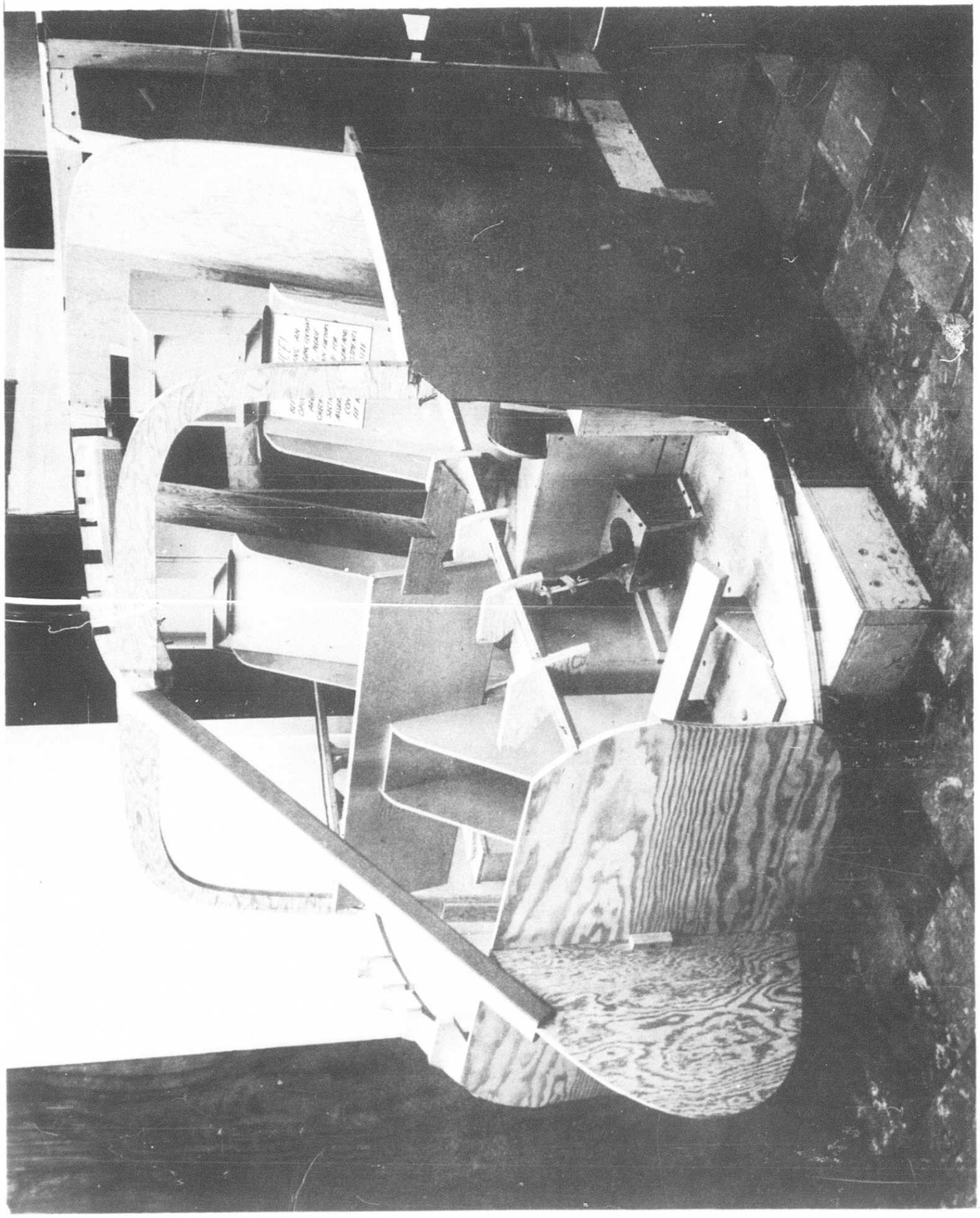

Figure 16. Human Factors Mock-up

Figure 17. Aft Crew Compartment – 5th and 95th Percentile (on Left)

VII. GENERAL

A. COMMENTS

With this report and in all future publications of monthly progress reports, this contractor is including listings of all open items which require action by the BuWeps or Bell Aerosystems. (see Section D).

B. TRIPS AND VISITORS

1. Trips

Date	Destination	Purpose
3/7	BuWeps (Washington)	Discuss VSS
3/11	Dynamic Devices Dayton, Ohio	Engineering liaison with Flutter Model Subcontractor
3/18	BuWeps (Washington)	Coordinate prop. system and discuss problems
3/19	BuWeps (Washington)	Discuss wheel, brake, and tire design requirements
3/20	BuWeps (Washington)	Discuss instrument panel and electrical system layout
3/20	Philadelphia, Pa. Kellett A/C	Observe Kellett tests
3/20	DTMB & Langley	Discuss elevon control data with NASA and 1/6 scale model with DTMB
3/24	Dynamic Devices Dayton, Ohio	Provide fultter model vendor with technical data and check progress and discuss drawings for NASA approval

3/25	DTMB	Participate in 1/2 and 1/6 scale wind tunnel tests
3/26	BuWeps (Washington)	Discuss Flight and Ground Loads Criteria Reports
3/27	BuWeps (Washington)	Discuss SAC Charts and PERT Report
3/27	Ames - NASA	Discuss full scale duct wind tunnel models design and installation
3/27	BuWeps (Washington)	Review landing gear specification and specification control drawings

2. Visitors

Data	Destination	Purpose
3/6	Hamilton Standard	Discuss propeller work statement and specification
3/6	Lockheed	Discuss ejection seats
3/8	Curtiss	Discuss transmission proposal
3/7	General Electric	Discuss engine requirements
3/8	General Electric	Discuss engine requirements
3/26	Cdr. Braun	General review
3/29	Kellett A/C	Presentation on downwash testing results

C. REPORTS AND CORRESPONDENCE SUBMITTED DURING MARCH 1963

BAC Letter No.	Date Submitted	To	Subject	Reason
84	3/1/63	BuWeps - RA-443	Correction of Wording SD-550-1	Approval
85	3/4/63	Aero Systems Division WPAFB, Ohio	Transmittal of Data	Info.
86	3/4/63	U.S.Army Transport. Res. Command SMOFE	Transmittal of Data	Info.
87	3/6/63	BuWeps - RA-443	BAC Support of Navy Flight Test Program	Info.
88	3/5/63	NASA, Langley Field, Va.	1/5 Scale Model Drawing	Approval
89	3/6/63	DTMB	Transmittal - General Arrangement	Info.
90	3/6/63	DTMB	1/3 Scale Model Drawing	Approval
91	3/6/63	BuWeps Aero and Hydrodynamics Br.	Transmittal of Report 1/6 Scale Model	Info.
92	3/6/63	BuWeps - RA-443	Change in Wording - SD-550-1	Approval
93	3/7/63	NASA, Langley Field, Va.	Transmittal of 1/5 Scale Model Drawings	Approval
94	3/12	BuWeps - RA-443	Ejection Seat	Approval
95	3/13	BuWeps - RA-443	PERT Reports	Info.
96	3/13	BuWeps - RA-443	PERT Reports	Info.
97	3/14	BuWeps - RA-443	Monthly Progress Report No. 3	Info.
98	3/14	BuWeps	Weight and Balance Status Report	Approval

C. CONT'D

BAC Letter No.	Date Submitted	To	Subject	Reason
99	3/15	BuWeps Rep.	Point of Performance	Info.
100	3/18	NASA	1/5 Scale Model Drawings	Approval
101	3/18	Aero Systems Division WPAFB, Ohio	Weight and Balance Status Report	Info.
102	3/18	U.S.Army Transport. Res. Command Ft. Eustis, Va.	Transmittal of Weight and Balance Status Report	Info.
103	3/19	DTMB	General Arrangement Drawing	Info.
104	3/19	BuWeps Rep.	Casings and Tubes - Specification MIL-D-5041	Approval
105-115	3/20,3/21	(See Section D - Dist. List)	Transmittal of Monthly Progress Report No. 3	Info.
116	3/21	NASA, Langley Field, Va.	1/5 Scale Model Drawings	Approval
117	3/21	BuWeps - RA-443	PERT Interim Report	Info.
118	3/22	BuWeps - NPR-2411	Schedule for Delivered Items	Info.
119	3/28	BuWeps - RA-443	Weapon System Master Plan	Approval
120	3/28	BuWeps - RA-443	Preliminary Wiring Diagram Electrical System	Approval
121	3/29	BuWeps - RA-443	Schedule of Structural Work	Approval
122	3/29	BuWeps - RA-443	Revised Pages (SD-550-1)	Approval

D. OPEN ITEMS

1. BuWeps and BuWeps Rep

BAC Letter No.	Subject	Date Submitted
28	Basic Aerodynamic Data Report - Revision (2127-917002)	1-24-63
31	Human Factors Data Report (2127-919001)	1-29-63
71	Variable Stability System - Transfer of Weight	2-22-63
74	Variable Stability System Specification (2127-947006)	2-26-63
75	Vibration Program Report (2127-932001)	2-27-63
76	Preliminary Load Analysis - Electrical System (2127-905001)	2-27-63
82	Flight Loads Criteria (2127-941003)	2-28-63
83	Ground Loads Criteria (2127-941004)	2-28-63
84	Revision to SD-550-1 Para. 3.1.2.1 (Endurance Requirement)	3-1-63
87	Proposed BAC Support - Navy Flight Test Program	3-5-63
92	Revision to SD-550-1 (Electronic Equipment)	3-6-63
94	Douglas Ejection Seat	3-12-63
98	Weight and Balance Status Report - Submittal Dates	3-14-63
104	Revision to SD-550-1 Para. 3.8.2.3 (MIL-T-5041D)	3-19-63
119	Weapon System Master Plan (2127-933051)	3-28-63
121	Revised Schedule of Structural Work (2127-941001)	3-29-63 (BWR)
122	Revised Pages - Contract Detail Spec.	3-29-63

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Aerodynamic and Flutter Model Test Program (BAC No. 2127-917001) Revision

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